



US006250686B1

(12) **United States Patent**
Becker et al.

(10) **Patent No.:** **US 6,250,686 B1**
(45) **Date of Patent:** **Jun. 26, 2001**

(54) **COMBINATION MECHANICAL/FUSION
PIPE FITTING**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/359,156**
(22) Filed: **Jul. 22, 1999**

Related U.S. Application Data

(60) Provisional application No. 60/117,110, filed on Jan. 25, 1999.

(51) **Int. Cl.⁷** **F16L 47/02**
(52) **U.S. Cl.** **285/21.2**; 285/423; 285/342
(58) **Field of Search** 285/423, 21.1,
285/21.2, 342, 343; 214/544; 156/274.2,
296

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,287,889	6/1942	Krumsiek et al.	285/166
2,473,118	* 6/1949	Wolfram	285/342
2,824,756	2/1958	Wagner	285/12
3,061,503	10/1962	Gould et al.	156/272
3,788,928	1/1974	Wise	156/294
3,830,532	* 8/1974	Roberts	285/342

4,083,587	* 4/1978	Leczycki	285/343
4,176,274	11/1979	Lippera	219/522
4,436,988	3/1984	Blumenkranz	219/544
4,493,985	1/1985	Keller	219/535
4,508,368	4/1985	Blumenkranz	285/21
4,877,270	10/1989	Phillips	285/18
4,927,183	* 5/1990	Steinmetz et al.	285/21.2
5,466,019	11/1995	Komolrochanaporn	285/343
5,516,159	5/1996	Hirakawa et al.	285/388
5,685,572	* 11/1997	Linton et al.	285/21.2

FOREIGN PATENT DOCUMENTS

239018	* 3/1965	(AT)	285/21
4214279	* 11/1993	(DE)	285/21
404145294	* 5/1992	(JP)	285/21
404321892	* 11/1992	(JP)	285/21
405248586	* 9/1993	(JP)	285/21
406159582	* 6/1994	(JP)	285/21

* cited by examiner

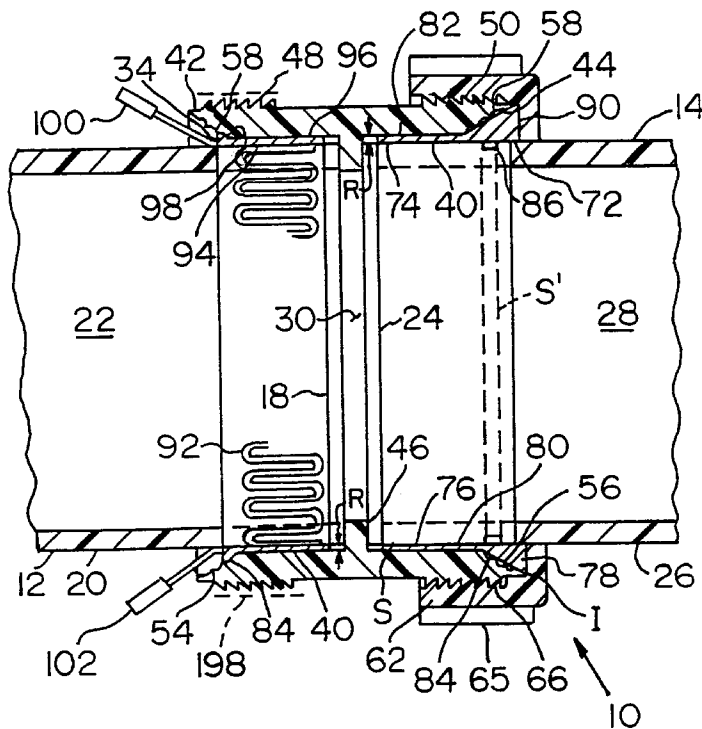
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(57) **ABSTRACT**

A piping system that includes a plurality of pipe made of thermoplastic material, a coupling and an arrangement for securing the pipe to the coupling. The coupling is configured so that either a fusible seal or mechanical seal can be used with the coupling to connect the pipe to the coupling. Preferably, the pipe and coupling are made of thermoplastic material.

34 Claims, 6 Drawing Sheets



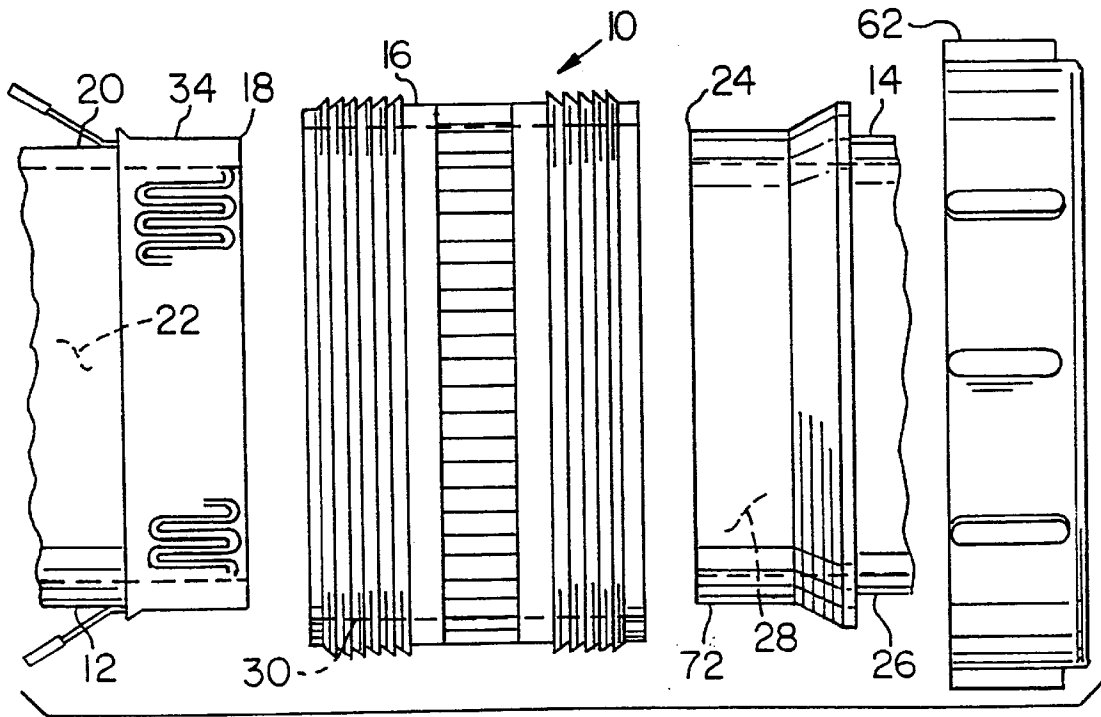


FIG. 1

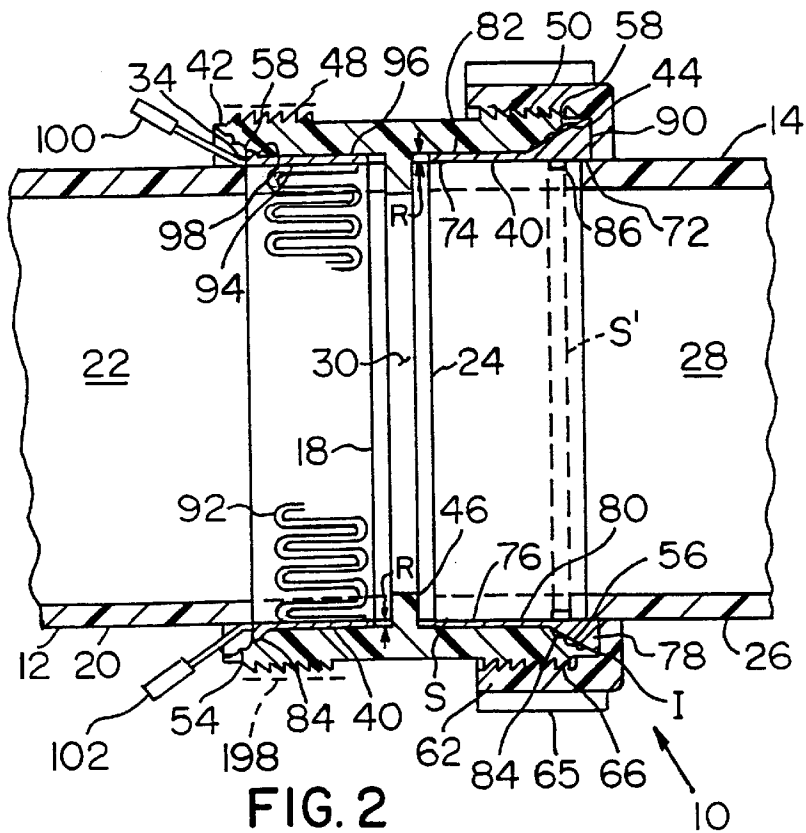


FIG. 2

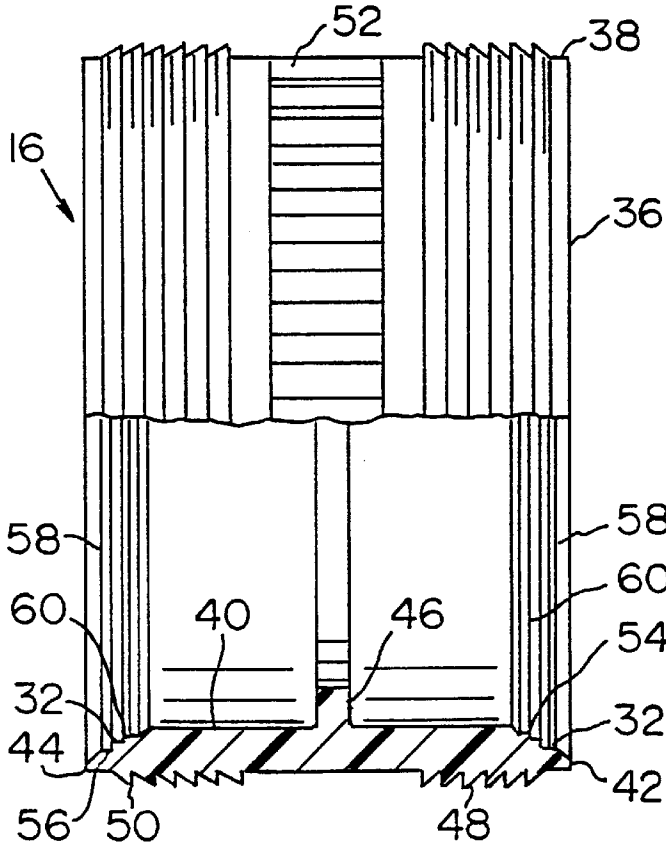


FIG. 3

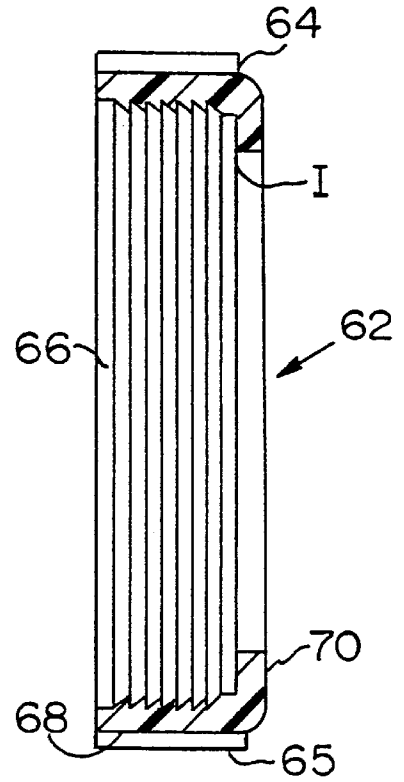


FIG. 4

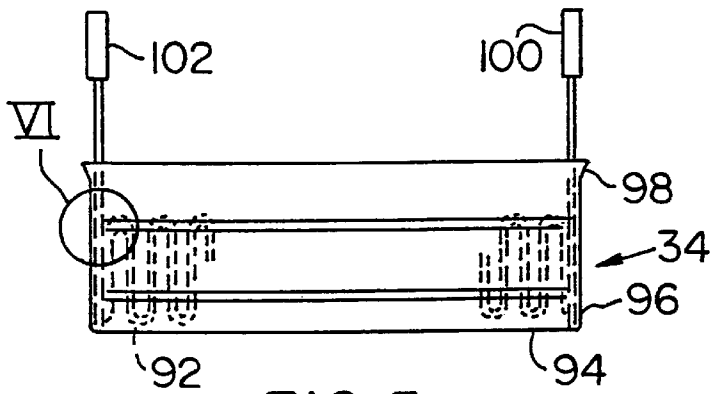


FIG. 5

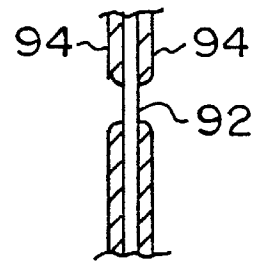


FIG. 6

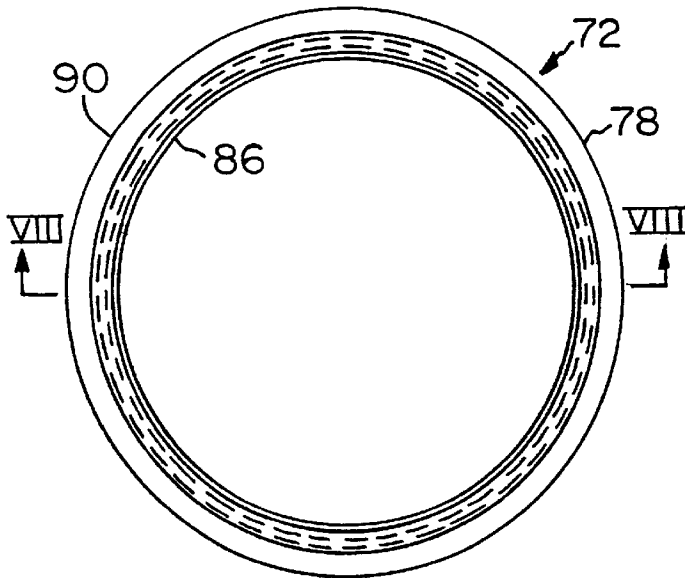


FIG. 7

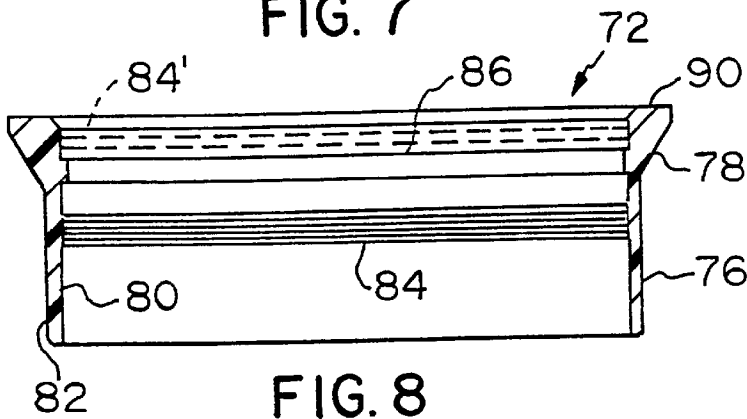


FIG. 8

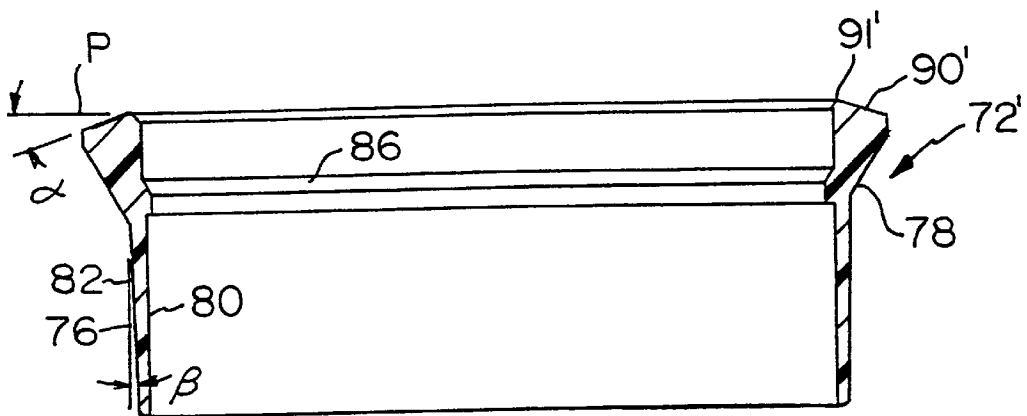


FIG. 9

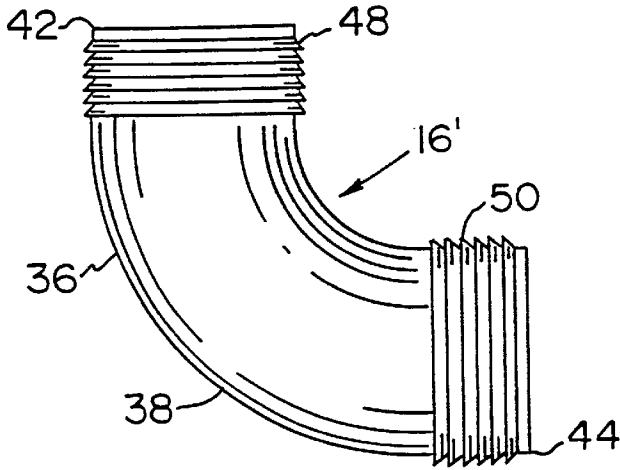


FIG. 10

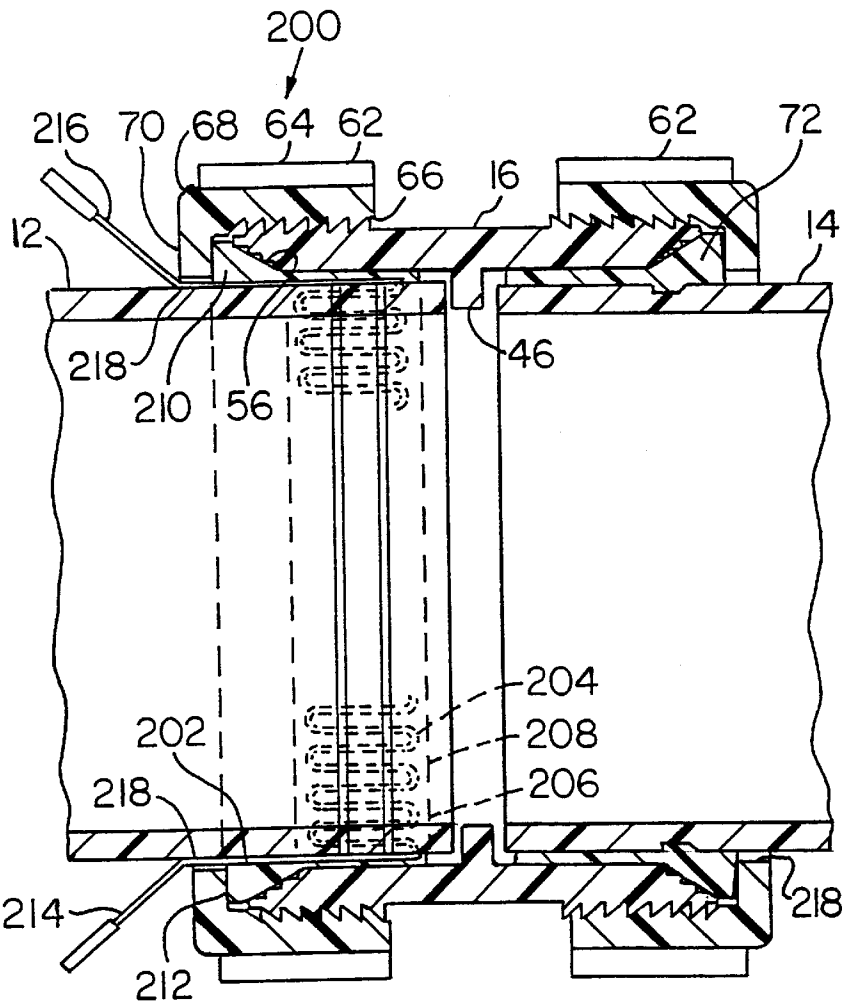
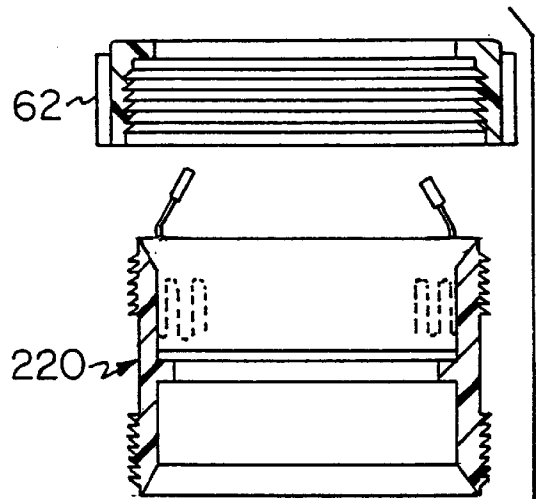
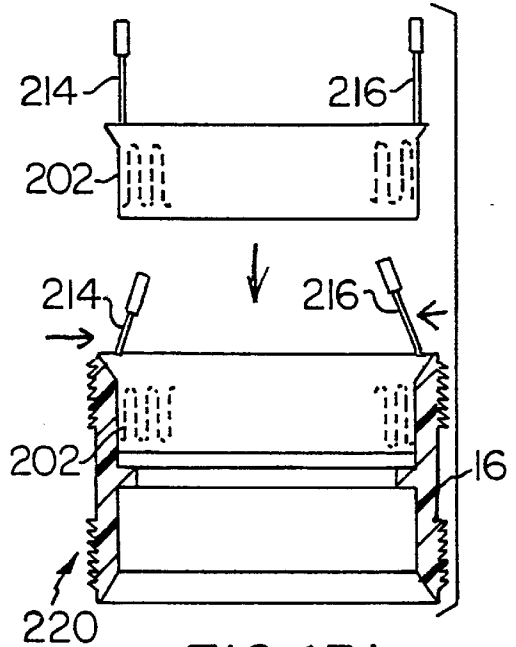
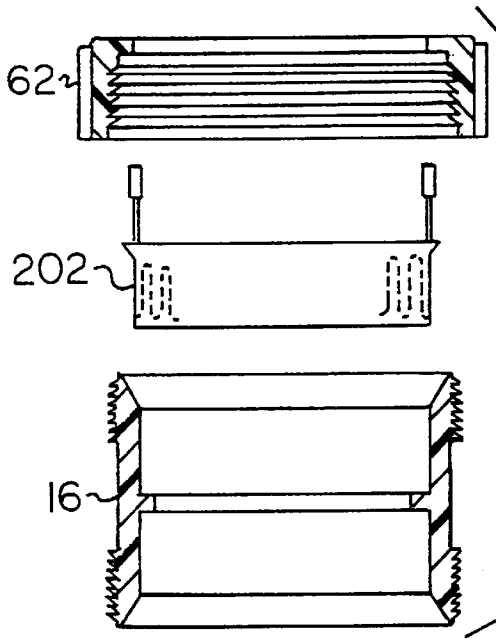
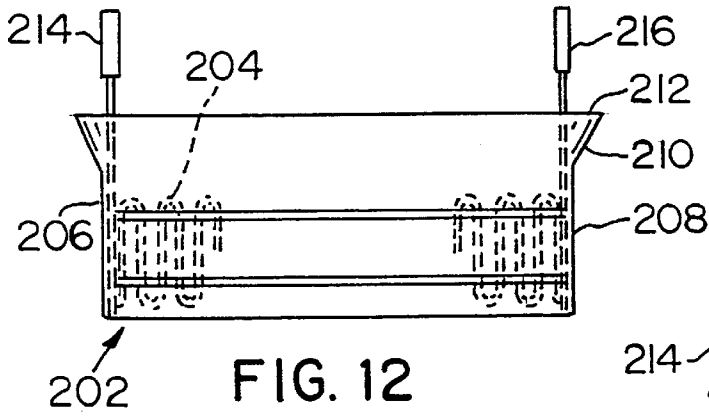


FIG. 11



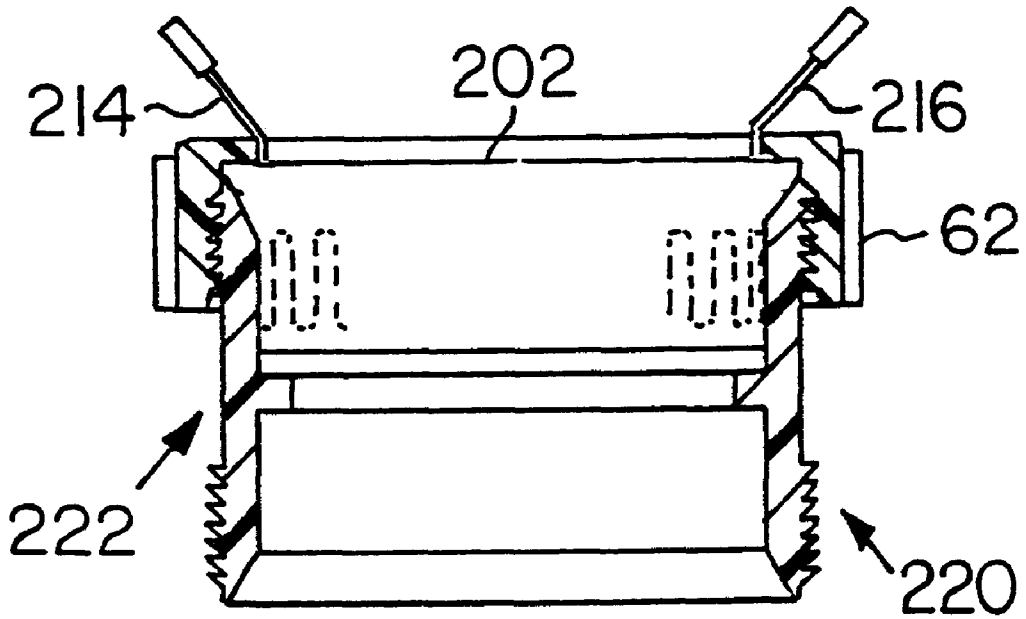


FIG. 13d

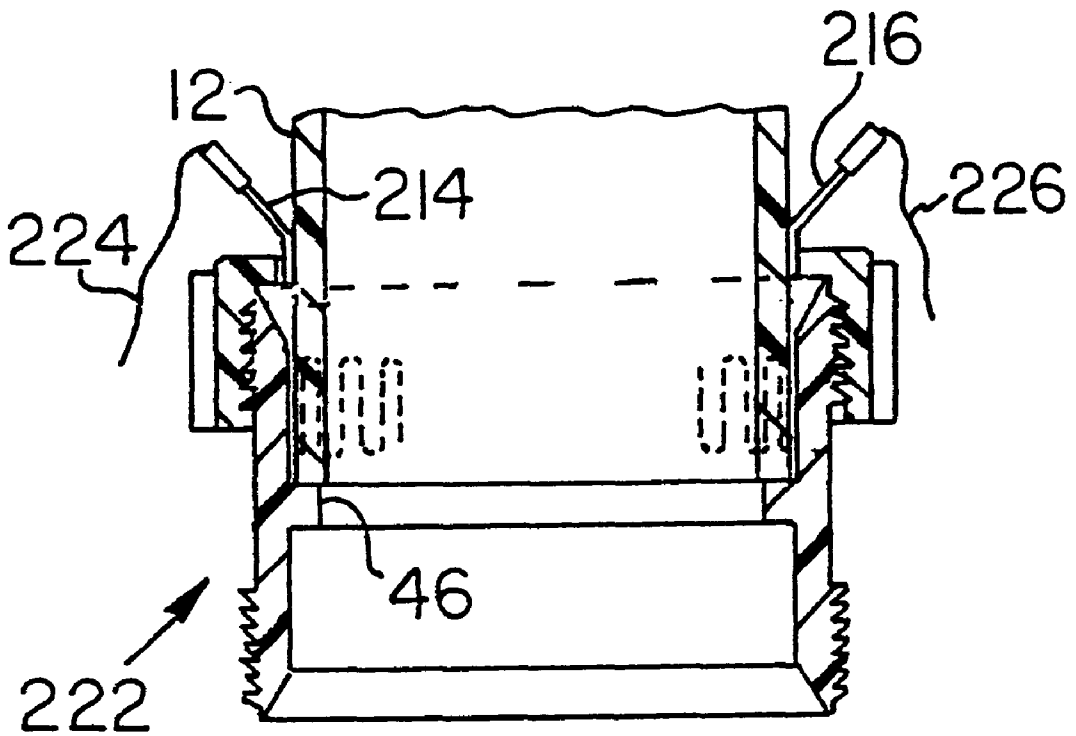


FIG. 13e

COMBINATION MECHANICAL/FUSION PIPE FITTING

BACKGROUND OF THE INVENTION

Cross Reference to Related Application

This application claims the benefit of U.S. Provisional Application Ser. No. 60/117,110, filed Jan. 25, 1999.

FIELD OF THE INVENTION

The present invention relates to coupling of plastic pipes and, more particularly to coupling of plastic pipes by fusion welding or through a mechanical seal.

DESCRIPTION OF THE PRIOR ART

Prior to the advent of plastic pipe, most piping was made out of metal, such as copper, stainless steel or iron. The particular metal used for the piping was dependent upon the application. For example, water could be transported through copper and/or cast iron pipes. However, acids had to be transported in stainless steel pipe. Some of the metal pipe, such as copper and stainless steel, was expensive to manufacture and install. Typically, the pipe was either brazed or welded together. In some instances, mechanical type joints were provided for pipe connections. In today's market, all of these arrangements are expensive to manufacture and install.

Plastic pipe overcomes many of the expenses associated with metal pipe. Plastic pipe is inexpensive to manufacture and relatively easy and inexpensive to connect together. In the case of thermoplastic materials, such as polypropylene, the pipe can be welded together by providing a polypropylene sleeve with electrical heating elements embedded therein. This process is known as fusion welding. Fusion welded pipe is particularly applicable in situations where acid passes through the plastic pipe. Polypropylene pipe can be secured to each other through mechanical seals. In some applications, mechanical seals are preferable to the fusion welding.

In the past, different pipe couplings were provided for fusion sealing and mechanical sealing. This resulted in an increase in inventory required by the installer, such as the mechanical contractor or plumber, since two separate types of couplings were required, one for mechanical sealing and the other for fusion welding.

Therefore, it is an object of the present invention to provide a single coupling for use with mechanical sealing and fusion welding of plastic pipe.

SUMMARY OF THE INVENTION

The present invention is a piping system that includes a first pipe, a second pipe, a coupling, an arrangement for securing the first pipe to the coupling and an arrangement for securing the second pipe to the coupling. The first pipe is made of thermoplastic material having a first pipe first end. The second pipe is made of thermoplastic material having a second pipe first end. The coupling includes a body having a coupling first end and a coupling second end. The body has an outer surface and an inner surface. The inner surface defines a passageway and a lip positioned between the coupling first end and the coupling second end. The first pipe first end is received by the coupling first end and the second pipe first end is received by the coupling second end. The first pipe first end and the second pipe first end are positioned on opposite sides of the lip.

The pipe coupling can include pipe coupling threads defined on the outer surface of the coupling configured to

engage with a nut, a first tapered inner surface adjacent the coupling first end and a second inner tapered surface adjacent the coupling second end and a plurality of circumferential rings defined on the inner surface. Axial ribs can be defined on the coupling outer surface and positioned between the threads positioned adjacent the coupling first end and the coupling second end.

The arrangement for securing the first pipe to the coupling and the arrangement for securing the second pipe to the coupling can be accomplished through a fusion seal or a mechanical seal. The fusion seal includes a sleeve made of thermoplastic material having an electrically resistive wire embedded therein and two leads attached to the electrically resistive wire extending from the sleeve. The sleeve is configured to be sandwiched between the pipe coupling and a thermoplastic pipe with the two leads extending from the piping coupling. The mechanical seal includes a flexible body received between the pipe coupling and the first pipe and a nut, the flexible body is held in place by the nut coacting with the pipe coupling and an end of the flexible body. The nut includes inner threads that coact with the pipe coupling threads. The nut includes an annular lip that defines a passageway configured to permit a thermoplastic pipe to pass there through, the annular lip contacts an end of the flexible body of the mechanical seal and holds the flexible body of the mechanical seal in place. The flexible body also includes a tapered portion adapted to coact with the first tapered inner surface of the pipe coupling.

The present invention can be provided as a kit for joining thermoplastic pipe together.

Further, the present invention is a method for joining two thermoplastic pieces of pipe, that includes the steps of:

- a) providing two pieces of thermoplastic pipe;
- b) attaching either a fusible seal or a mechanical seal at the ends of each the pieces of thermoplastic pipe;
- c) passing the ends of the pieces of thermoplastic pipe with the seals through ends of a thermoplastic pipe coupling and sandwiching the seals between the pipe coupling and the pieces of thermoplastic pipe; and
- d) forming a fluid tight seal between the pieces of thermoplastic pipe and the pipe coupling by either compressing the mechanical seal with a nut coacting with the pipe coupling or heating the sleeve until the sleeve and adjacent portions of the pipe coupling and the pipe melt.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded elevational view of a pipe coupling system that includes pipe, a fusion seal, a mechanical seal, a coupling and a nut made in accordance with the present invention;

FIG. 2 is an elevational view, partially in section, of the piping coupling system shown in FIG. 1;

FIG. 3 is a elevational view, partially in section, of the coupling shown in FIG. 1;

FIG. 4 is a sectional elevational view of the nut shown in FIG. 1;

FIG. 5 is an elevational view of the fusion seal shown in FIG. 1;

FIG. 6 is a partial sectional view of a portion of the fusion seal shown in FIG. 5;

FIG. 7 is a plan view of the mechanical seal shown in FIG. 1;

FIG. 8 is a section taken along line VIII—VIII of FIG. 7;

FIG. 9 is a section of a second embodiment of a mechanical seal similar to the section shown in FIG. 8;

FIG. 10 is an elevational view of an elbow-shaped coupling made in accordance with the present invention;

FIG. 11 is another embodiment of a pipe coupling system made in accordance with the present invention;

FIG. 12 is an elevational view of the second embodiment of a fusion seal made in accordance with the present invention and shown in FIG. 11; and

FIGS. 13a-13e are representations showing a sequence of steps for joining pipe together with the fusion seal shown in FIGS. 11 and 12.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a pipe coupling system 10 made in accordance with the present invention. The pipe coupling system 10 includes a first thermoplastic pipe 12 and a second thermoplastic pipe 14 secured to each other by a pipe coupling or pipe fitting 16. Preferably, the first thermoplastic pipe 12 and the second thermoplastic 14 are made of a polypropylene, such as a polypropylene from Montell North America, Three Little Falls Centre, 2801 Centerville Road, Wilmington, Del. 19808. The first thermoplastic pipe 12 includes a first thermoplastic pipe first end 18 and a first thermoplastic pipe outer surface 20. A first thermoplastic pipe passageway 22 is defined by an inner surface of the first thermoplastic pipe. The second thermoplastic pipe 14 includes a second thermoplastic pipe 14 first end 24 and a second thermoplastic pipe outer surface 26. An inner surface of the second thermoplastic pipe 14 defines a second thermoplastic pipe passageway 28. The pipe coupling 16 includes an inner surface that defines a pipe coupling passageway 30. As shown in FIG. 2, the first thermoplastic pipe passageway 22, the second thermoplastic pipe passageway 28 and the pipe coupling passageway 30 are in fluid communication with each other. Generally speaking, the first thermoplastic pipe 12, the second thermoplastic pipe 14 and the pipe coupling 16 are substantially cylindrically in shape. However, the passageways defined therein may take other forms, such as square.

Referring to FIGS. 2 and 3, the pipe coupling 16 includes a mechanical sealing surface 32 and is adapted or configured to receive a fusion seal 34. Preferably, the pipe coupling 16 is made of thermoplastic material, which is the same thermoplastic material used for the first thermoplastic pipe 12 and the second thermoplastic pipe 14. Referring specifically to FIG. 3, the pipe coupling 16 includes a pipe coupling body 36 having a pipe coupling outer surface 38 and a pipe coupling inner surface 40. The pipe coupling 16 includes a pipe coupling first end 42 and an oppositely positioned pipe coupling second end 44. An annular lip 46 is defined by the pipe coupling inner surface 40 midway between the pipe coupling first end 42 and the pipe coupling second end 44, which are positioned on opposite sides of the annular lip 46. A first set of threads 48 is defined adjacent the pipe coupling first end 42 and a second set of threads 50 is defined adjacent the pipe coupling second end 44. The threads 48 and 50 are defined as the pipe coupling outer surface 38. Axially extending exterior ribs 52 are circumferentially spaced about the pipe coupling outer surface 38. Alternatively, a plurality of flat surfaces can be provided in lieu of the exterior ribs 52, to form a geometric shape, such as a hexagon or octagon. The exterior ribs 52 are positioned between the first set of threads 48 and the second set of threads 50. A first inner tapered surface 54 and a second inner tapered surface 56 are

defined by the pipe coupling inner surface 40 and are adjacent the pipe coupling first end 42 and the pipe coupling second end 44. Respective pipe coupling surface 40 and tapered surfaces 54 and 56, define a first receiving profile and a second receiving profile, which are coaxial with respective thermoplastic pipes 12 and 14. As can be seen in FIG. 2, the receiving profiles are configured to receive either a fusion seal 34 or a mechanical seal 72. A plurality of inwardly positioned axially spaced circumferential rings 58 (such as two, three or four rings) are positioned on the first inner tapered surface 54 and the second inner tapered surface 56. Recesses 60 are defined between the circumferential rings 58.

FIGS. 2 and 4 show a nut 62 that is used in the pipe coupling system 10 when a mechanical seal is used and configured to coact with the first set of threads 48 and the second set of threads 50 of the pipe coupling 16. The nut 62 is preferably made of a polypropylene and includes a body 64. Preferably, the nut 62 is made of the same thermoplastic material as the coupling 16. Axially extending ribs 65 are positioned about an outer surface of the body 64. Inner threads 66 are defined about an inner surface of the body 64. The body includes cylindrical first portion 68 that includes the inner threads 66, and an annular lip second portion 70 that is integrally connected to the cylindrical first portion 68. A passageway is defined by the annular lip 70 and the cylindrical first portion 68 through which a thermoplastic pipe, such as the first thermoplastic pipe 12 and the second thermoplastic pipe 14, can extend.

FIGS. 2, 7 and 8 show a mechanical seal 72 made in accordance with the present invention. Preferably, the mechanical seal 72 is flexible and made of a low density polyethylene (LDPE), which is manufactured by Mobil Polymers, 2195 Lincoln Highway, Edison, N.J. The mechanical seal 72 is adapted to be received between a gap 74 defined between a pipe, in this case the second thermoplastic pipe 14, and the pipe coupling 16, as shown in FIG. 2. The mechanical seal 72 includes a flexible body having a cylindrical portion 76 integrally attached to a tapered portion 78. The mechanical seal 72 includes a substantially cylindrical inner surface 80 and an outer surface 82. A plurality of inner circumferential rings 84 are defined on the inner surface 80 of the cylindrical portion 76 and a ring 86 is defined on the inner surface 80 of the tapered portion 78. Alternatively, the inner circumferential rings 84 may be eliminated or a circumferential ring 84', shown in phantom, can be provided. The circumferential rings 84 and ring 86 are adapted to sealingly coact with an outer pipe surface "s", which in this case is the second thermoplastic pipe outer surface 26. The ring 86 is adapted to be received in a recess defined in the outer pipe surface for alignment of the mechanical seal 72 on the respective pipe. An abutting end 90 is defined on the tapered portion of the mechanical seal 72.

FIG. 9 shows a second embodiment of a mechanical seal 72', which is similar to the mechanical seal 72, except for the below noted differences. The mechanical seal 72' includes an angled abutting end 90'. An angle α of the angled abutting end 90' is defined from a plane P and is preferably between 5° - 10° . An uppermost portion 91' is adapted to be positioned adjacent the outer pipe surface "s". The outer surface 82 of the cylindrical portion 76 can have a slight taper such as 1° as represented by the angle β . The previously described circumferential rings 84 and 84' may be provided.

FIGS. 2, 5 and 6 show the fusion seal 34 made in accordance with the present invention. The fusion seal 34 includes a circumferential-looped electrical resistive wire 92

embedded within a cylindrical thermoplastic sleeve **94**. Preferably, the electrical resistive wire or heating element **92** is made out of nickel-chrome or a normal heating wire with nickel plate. Preferably, the electrical resistive wire **92** is made of eighteen (18) gage wire and has a resistance measured in ohms per inch. The resistance of the wire varies depending on the application. Further, preferably the thermoplastic sleeve is made of a polypropylene, such as that previously described and used for the thermoplastic pipe **12** and **14**. The thermoplastic sleeve **94** includes a cylindrical portion **96** and an integral tapered portion **98**, which is positioned directly adjacent the termination of the cylindrical portion. Exposed electrical resistive wire lead **100** and **102** are attached to the resistive wire **92**.

The method of connecting, the first thermoplastic pipe **12** to the second thermoplastic pipe **14** using the coupling **16** is set forth as follows. Initially, the installer must decide whether the thermoplastic pipes **12** and **14** are to be mechanically sealed or sealed through fusion welding. In some instances, one of the thermoplastic pipe **12** or **14**, is to be mechanically sealed to the pipe coupling **16** and the other of the thermoplastic pipe **12** or **14** is to be fusion welded to the pipe coupling **16**. For the purpose of example, the latter situation, which is shown in FIGS. **1** and **2**, is described as follows.

The fusion seal **34** is slid over the first thermoplastic pipe first end **18**, as shown in FIG. **2**. The tapered portion **98** of the fusion seal **34** is positioned away from the first thermoplastic first end **18** and the cylindrical portion **96** of the fusion seal **34** is positioned adjacent the first thermoplastic pipe first end **18**. The first thermoplastic pipe first end **18** with the fusion seal **34** is then positioned through and received by the pipe coupling first end **18** and within the pipe coupling **36** until the first thermoplastic pipe first portion **18** abuts against the annular lip **46**. In this arrangement, the cylindrical portion **96** abuts against the pipe coupling inner surface **40** and the tapered portion **98** of the fusion seal **34** abuts against a portion of the first inner tapered surface **54**. Preferably, the tapered portion **98** abuts against one of the circumferential rings **84**, as shown in FIG. **2**. The electrical resistive wire leads **100** and **102** extend away from the pipe coupling **16** and the pipe **12**. Preferably, the thickness of the gap **74**, as designated by R, is less than or equal to the thickness of the thermoplastic sleeve **94**. Therefore, the thermoplastic sleeve **94** is sandwiched and compressed between the pipe coupling **16** and the pipe **12**. Preferably, a clamp **198** (shown in phantom in FIG. **2**), such as model number 942AD-0550 H98, manufactured by Clamco of Wadsworth, Ohio, is placed around the pipe coupling outer surface and over the sleeve **94**. The clamp is tightened to apply radial pressure and force to the pipe **12**, pipe coupling **16** and the sleeve **94**.

Electric current, having a voltage of typically 120 volt AC (alternating current), is passed through the resistive wire **92** via the leads **100** and **102**. The electric current causes the resistive wire **92** to heat, thereby causing the thermoplastic sleeve **94** and adjacent portions of thermoplastic pipe **12** and the pipe coupling **16** to melt. After a period of time, the electric current is stopped from passing through the resistive wire **92**. The thermoplastic of the pipe **12**, the pipe coupling **16** and the sleeve **94** are permitted to cool and harden, thereby forming a fluid tight seal between the first thermoplastic pipe **12** and the coupling **16**. The clamp **200** is removed. The exposed leads **100** and **102** and the exposed resistive wire **92** may then be cut and removed from the thermoplastic sleeve **94**. Alternatively, the exposed leads **100** and **102** can be left alone for future heating and melting

of the thermoplastic sleeve **94**, should a leak develop or the pipe need to be replaced.

Referring again to FIG. **2**, the mechanical seal **72** is slidably received by the second thermoplastic pipe **14** so that the tapered portion **78** is positioned away from the second thermoplastic pipe first end **24** and the cylindrical portion **76** of the mechanical seal **72** is positioned adjacent the second thermoplastic pipe first end **24**. Preferably, an annular slot "s" is defined on the second thermoplastic pipe outer surface **26** near the second thermoplastic pipe first end **24** so that the ring **86** is received therein for aligning the mechanical seal **72** with the thermoplastic pipe first end **24** and the coupling **16**. The inner circumferential rings **84** abut against the second thermoplastic pipe outer surface **26**. The second thermoplastic pipe **14** is then inserted into and received by the pipe coupling second end **44** until the second thermoplastic pipe first end **24** nearly abuts against the annular lip **46**. In this arrangement, the cylindrical portion **76** of the mechanical seal **72** is positioned between the second thermoplastic pipe outer surface **26** and the pipe coupling inner surface **40**. The tapered portion **78** of the mechanical seal **72** abuts against the second inner tapered surface **56**. The circumferential rings **58** positioned on the second inner tapered surface **56** of the pipe coupling **36** contact the tapered portion **78** of the mechanical seal **72**. The abutting end **90** of the mechanical seal **72** extends beyond the pipe coupling second end **44**. The nut **62**, which is initially slid onto the second thermoplastic pipe **14** through the annular lip **70** and cylindrical first portion **68**, is then threadably engaged with the second set of threads **50** until an inner surface I of the annular lip **70** contacts the abutting end **90**. The nut **62** is further tightened, preferably with wrenches or other tightening mechanism, which engage with axial ribs **65** of the nut **62** and the axially extending exterior ribs **52** of the pipe coupling **16**, urging the mechanical seal **72** toward the annular lip **46** of the pipe coupling **16**. This action causes the mechanical seal **72** to expand in the radial direction and compress along the axial direction, thereby forming a fluid seal between the second thermoplastic pipe **14** and the pipe coupling **16**. In other words, the flexible body of the mechanical seal **72** is held in place by the nut **62** coating with the pipe coupling **16** and the abutting end **90**. The seal **72** can be used in lieu of seal **72**. It has been found that the angled abutting end **90**' improves engagement of the seal **72**' by concentrating the force applied by the nut **62** to the uppermost portion **91**'. It is believed that the angled abutting end **90**' eliminates the need of heating the mechanical seal to slip over the thermoplastic pipe which may be necessary in prior art mechanical seal arrangements.

In many instances, pipe will be connected to both ends of the pipe coupling **16** in the same manner, i.e., either through mechanical seals **72** or fusion seals **34**. It should be understood that the pipe coupling system shown in FIG. **2** could include two mechanical seals **72** or two fusion seals **34** as opposed to one mechanical seal **72** and one fusion seal **34**. As should be evident, the nut **62** is only used with the mechanical seal.

The present invention overcomes the disadvantage of the prior art, which requires separate inventory for fusion seal type couplings and mechanical seal type couplings. The present invention utilizes only one pipe coupling design for both mechanical seals and fusion seals. The nuts **62**, the fusion seals **34** and the mechanical seals **72** are used on an as needed basis. The present invention, thereby, reduces the cost for tooling of separate couplings. Further, the present invention provides for an easy installation of mechanical seals where fusion seals are not necessary. In the case of

mechanical seals, the present invention does not require the mechanical seals to be heated for the seals to be easily slid onto the pipe, as is the case in the prior art.

FIG. 10 shows a second embodiment of the pipe coupling designated as pipe coupling 16'. Pipe coupling 16' is the same as pipe coupling 16 except that it is in the form of an elbow fitting as opposed to a substantially cylindrical shape, as shown in FIGS. 1-3. All other aspects of the pipe coupling 16' are the same as pipe coupling 16.

FIGS. 11-13e show another embodiment of a pipe coupling system 200 made in accordance with the present invention. The pipe coupling system 200 incorporates many of the previously described parts and therefore like reference numerals will be used for like parts.

Referring to FIG. 11, the pipe coupling system 200 includes a first thermal plastic pipe 12, a second thermal plastic pipe 14 secured to each other by a pipe coupling or pipe fitting 16. The second thermoplastic pipe 14 is secured to the coupling 16 through a mechanical seal 72 and a nut 62 in the manner previously described herein. The first thermoplastic pipe 12 is secured to the pipe coupling 16 through a nut 62 and a fusion seal 202 made in accordance with the present invention.

Referring to FIGS. 11 and 12, the fusion seal 202 is similar to the fusion seal 34 previously described herein. Specifically, the fusion seal 202 includes a circumferential-looped electrical resistive wire 204 embedded within a cylindrical thermoplastic sleeve 206. Preferably, the electrical resistive wiring heating element 204 is made of nickel-chrome or a normal heating wire with nickel plate. Preferably, the electrical resistive wire 204 is made of eighteen (18) gauge wire and has a resistance measured in ohms per inch. The resistance of the wire varies depending on the application. Further, preferably the thermoplastic sleeve is made of polypropylene, such as that previously described and used for the fusion seal 34. The thermoplastic sleeve 206 includes a cylindrical portion 208 and an integral tapered portion 210. The tapered portion 210 includes abutting end 212. Exposed electrical resistive wire leads 214 and 216 are attached to the resistive wire 204. As should now be evident, the difference between the fusion seal 34 and the fusion seal 202 is the relative size of the tapered portions 98 and 210, respectively.

The method of connecting the first thermoplastic pipe 12 to the coupling 16 using the fusion seal 202 shown in FIG. 13a is set forth as follows. Initially, the installer places the fusion seal inside of the pipe coupling 16 so that the cylindrical portion 208 of the fusion seal 200 is received within the interior of the pipe coupling 16 and the tapered portion 210 abuts against the tapered surface 56 of the pipe coupling 16. The installer then bends the wire leads 214 and 216 inwardly, as shown in FIG. 13b forming a first subassembly 220. FIG. 13b shows the fusion seal 202 separately and the first subassembly 220 separately. Then the nut 62 is threadably received by the coupling 16 via pipe coupling threads 50 so that the leads 214 and 216 pass through the nut opening defined by the annular lip 70 and the abutting end 212 abuts against an inner surface of the annular lip 70 and the tapered portion 210 is sandwiched between the annular lip 70 and the tapered surface 56 of the pipe coupling as shown in FIG. 13c. During tightening of the nut 62 onto the coupling 16, the inner surface of the annular lip 70 is pushed down and compresses the tapered portion 210. The wire leads 214 and 216 are then bent outwardly forming a second subassembly 222, as shown in FIG. 13d. In this arrangement, a portion of the tapered portion 210 extends beyond an end of the pipe coupling 16, as shown in FIG. 11.

An end of the first thermoplastic pipe 12 is passed through a portion of the second subassembly 222 until it abuts against or is positioned near the annular lip 46 of the pipe coupling 16, as shown in FIG. 13e. As can be seen in FIGS. 11 and 13e, the pipe leads 212 and 214 pass through a gap 218 defined between an inner surface of the annular lip 70 and an outer surface of the first thermoplastic pipe 12. Preferably, the inner diameter of the thermoplastic sleeve 206 is slightly less than the outer diameter of the first thermoplastic pipe 12 so that a pressed fit is formed. Further, after the first thermoplastic pipe 12 is placed within the second subassembly 222, the respective nut 62 is further tightened with a spanner to further compress the tapered portion 210, thereby causing the thermoplastic sleeve 206 to be forced against the outer surface of the first thermoplastic pipe 12. Leads 224 and 226 are then connected to wire leads 214 and 216 and electric current, as previously described, is passed through the leads 224 and 226, causing the thermoplastic sleeve 202 and adjacent portions of the thermoplastic pipe 12 and pipe coupling 16 to melt as previously described.

The fusion seal 202 eliminates the need for clamps that are typically associated with fusion seals, such as hub clamps. The hub clamps are tightened around the pipe section implementing the fusion seal and whereby, after the fusion seal is sealed between the pipe and the coupling, the hub clamp is removed. The purpose of the hub clamp is to place pressure around the fusion seal and the coupling and pipe. This is eliminated by use of the present invention. Further, the present invention provides a more aesthetically pleasing appearance of the fused joint whether a mechanical or a fusion seal is also implemented on the other side of the coupling 16, since nuts 62 are always positioned on opposite sides of the pipe coupling 16 irrespective of whether a mechanical seal or a fusion seal is used.

The present invention can be supplied as a kit for connecting thermoplastic pipe when the kit includes a coupling 16 or 16' and related accessories including one or more nuts 62, fusion seals 34 or 202 and mechanical seals 72 or 72'. Also, although thermoplastic is the preferable material for the components making up the invention, it is contemplated that other plastic materials or copolymers can be used.

Although the present invention has been described in detail in connection with the discussed embodiments, various modifications may be made by one of ordinary skill in the art without departing from the spirit and scope of the present invention. Therefore, the scope of the present invention should be determined by the attached claims.

We claim:

1. A piping system incorporating a mechanical seal and/or a fusion seal comprising:
 - a first pipe made of thermoplastic material having a first pipe first end;
 - a second pipe made of thermoplastic material having a second pipe first end;
 - a coupling for receipt of either a mechanical seal or a fusion seal having a body, said body having a coupling first end and a coupling second end, said body having an outer surface and an inner surface, said inner surface defining a passageway, a first receiving profile and a second receiving profile, said inner surface including a lip positioned between said coupling first end and said coupling second end, said first pipe first end received by said coupling first end, said second pipe first end received by said coupling second end, said first pipe first end and said second pipe first end spaced on

opposite sides of said lip, said first receiving profile positioned coaxial with said first pipe and said second receiving profile positioned coaxial with said second pipe;

first means for securing said first pipe to said coupling; and

second means for securing said second pipe to said coupling, said first means and said second means, comprising either a mechanical seal or a fusion seal whereby said first receiving profile and said second receiving profile are configured to receive either said fusion seal or said mechanical seal.

2. A piping system as claimed in claim 1, wherein said pipe coupling includes threads defined on said outer surface of said coupling adjacent said coupling first end and said coupling second end.

3. A piping system as claimed in claim 2, further comprising axially extending ribs defined about said coupling outer surface and positioned between said threads positioned adjacent said coupling first end and said coupling second end.

4. A piping system as claimed in claim 1, wherein said coupling includes a first inner tapered surface adjacent said coupling first end and a second inner tapered surface adjacent said coupling second end.

5. A piping system as claimed in claim 4, further comprising a plurality of circumferential rings defined on said first inner tapered surface and said second inner tapered surface.

6. A piping system as claimed in claim 4, wherein said pipe coupling includes threads defined on said outer surface of said coupling adjacent said coupling first end and said coupling second end.

7. A piping system as claimed in claim 6, further comprising axially extending ribs defined about said coupling outer surface and positioned between said threads positioned adjacent said coupling first end and said coupling second end.

8. A piping system as claimed in claim 7, further comprising a plurality of circumferential rings defined on said first inner tapered surface and said second inner tapered surface.

9. A piping system as claimed in claim 1, wherein said fusion seal comprises a sleeve made of thermoplastic material having an electrically resistive wire embedded therein; and

two leads attached to said electrically resistive wire extending from said sleeve, said sleeve sandwiched between said pipe coupling and said first pipe with said two leads extending from said pipe coupling.

10. A piping system as claimed in claim 1, wherein said mechanical seal includes a flexible body received between said pipe coupling and said first pipe; and a nut, said flexible body held in place by said nut coacting with said pipe coupling and an end of said flexible body.

11. A piping system as claimed in claim 10, wherein said pipe coupling further includes pipe coupling threads defined on said outer surface of said coupling threadably engaged with said nut;

a first tapered inner surface adjacent said coupling first end and a second inner tapered surface adjacent said coupling second end; and

a plurality of circumferential rings defined on said inner surface, said mechanical seal body sealingly contacting said first tapered inner surface and circumferential ribs, and positioned between said first pipe and said pipe coupling.

12. A piping system as claimed in claim 11, wherein said nut includes inner threads that coact with said pipe coupling threads, said nut includes an annular lip that defines a passageway through which said first pipe passes, said annular lip contacts an end of said flexible body of said mechanical seal and holds said flexible body of said mechanical seal in place.

13. A piping system as claimed in claim 12, wherein said flexible body of said mechanical seal comprises a tapered portion adapted to coact with said first tapered inner surface of said pipe coupling.

14. A piping system as claimed in claim 13, wherein said flexible body of said mechanical seal includes an inner surface having a circumferential rings defined on an inner surface for coating with said first pipe.

15. A piping system as claimed in claim 13, further comprising a ring extending from an inner surface of said flexible body of said mechanical seal for coacting with a recess defined on an outer surface of said pipe for aligning said mechanical seal, said first pipe and said pipe coupling.

16. A piping system as claimed in claim 9, wherein said sleeve includes a tapered end adapted to coact with a tapered inner surface of said coupling.

17. A piping system as claimed in claim 16, wherein said electrically resistive wire is looped circumferentially within said sleeve.

18. A piping system as claimed in claim 1, wherein said coupling is in the shape of an elbow.

19. A piping system as claimed in claim 1, wherein said first pipe first end and said second pipe first end abut against said lip.

20. A pipe coupling for use with a thermoplastic fusible seal and a mechanical seal, comprising:

a body having a first end and a second end, said body having an outer surface and an inner surface, said inner surface defining a passageway, said inner surface defining a passageway, a first receiving profile and a second receiving profile, wherein said first receiving profile and said second receiving profile are configured to receive either the fusion seal or the mechanical seal; threads defined on said outer surface of said coupling adjacent said first end and said second end; a first inner tapered surface adjacent said first end; and a second inner tapered surface adjacent said second end, said first inner tapered surface and said second inner tapered surface, each including a circumferential ring.

21. A mechanical seal for use with a pipe and a pipe coupling having a body with an inner surface and an outer surface, wherein threads are defined on the outer surface of the pipe coupling, the inner surface of the pipe coupling including a tapered surface adjacent an end of the pipe coupling, said mechanical seal comprising:

a flexible mechanical seal body configured to be received between the pipe coupling and the pipe, said flexible mechanical seal body having a tapered portion adapted to contact the tapered surface of the pipe coupling, wherein said tapered portion includes an angled end, and said flexible mechanical seal body having a ring configured to contact an outer surface of the pipe, said tapered portion configured to be pressed against the pipe and the pipe coupling by a nut that is threadably secured to said pipe coupling threads, said angled end of said flexible mechanical seal body adapted to contact the nut.

22. A kit for joining thermoplastic pipe together comprising:

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- a pipe coupling, wherein said pipe coupling includes a thermoplastic body, said body having a first end and a second end, an outer surface defining threads and an inner surface, said inner surface defining a passageway, a first inner tapered surface adjacent said pipe coupling first end and a second inner tapered surface adjacent said pipe coupling second end;
- a mechanical seal, wherein said mechanical seal includes a flexible mechanical seal body having a tapered portion adapted to coact with one of said first inner tapered surface and said second inner tapered surface, said mechanical seal flexible body having an inner surface configured to sealingly receive a thermoplastic pipe;
- a fusion seal, wherein said fusion seal includes a thermoplastic sleeve having a heating element, said sleeve includes a tapered end adapted to coact with one of said first inner tapered end and said second inner tapered end, said sleeve having an inner surface configured to receive a thermoplastic pipe; and
- a nut, said nut having a body with threads configured to be threadably received by said pipe coupling and adapted to contact said tapered portion of said flexible mechanical seal body when said flexible mechanical seal body is received by said pipe coupling.
- 23.** A method for joining two thermoplastic pieces of pipe, comprising the steps of:
- providing two pieces of thermoplastic pipe;
 - providing a mechanical seal and a fusible seal;
 - attaching either the fusible seal or the mechanical seal on ends of each of the pieces of thermoplastic pipe;
 - passing the ends of the pieces of thermoplastic pipe with the seals through ends of a thermoplastic pipe coupling and sandwiching the seals between the pipe coupling and the pieces of thermoplastic pipe; and
 - forming a fluid tight seal between the thermoplastic pieces of pipe and the pipe coupling by either compressing the mechanical seal with a nut coacting with the pipe coupling or heating the sleeve until the sleeve and adjacent portions of the pipe coupling and the pipe melt.
- 24.** A pipe coupling system as claimed in claim 16, further comprising a nut, said sleeve held in place by said nut coacting with threads defined on said pipe coupling and said tapered end of sleeve.
- 25.** A piping system as claimed in claim 16, wherein said electrically resistive wire is looped circumferentially within said sleeve.
- 26.** A fusion seal for use with a pipe and a pipe coupling having a body with an inner surface and an outer surface, wherein threads are defined on the outer surface of the pipe coupling, the inner surface of the pipe coupling including a tapered surface adjacent an end of the pipe coupling, said fusion seal comprising:
- a fusion seal body configured to be received between said pipe coupling and said pipe, said fusion seal body having a sleeve made of thermoplastic material with a cylindrical portion having an electrically resistive wire embedded therein and a tapered portion attached to the cylindrical portion and positioned directly adjacent the termination of said cylindrical portion adapted to contact the tapered surface of said pipe coupling, said tapered portion configured to be pressed against said pipe and said pipe coupling by a nut that is threadably secured to said pipe coupling threads.
- 27.** A fusion seal as claimed in claim 26, wherein said electrically resistive wire is looped circumferentially within said sleeve.

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- 28.** A piping system comprising:
- a first pipe made of thermoplastic material having a first pipe first end;
- a second pipe made of thermoplastic material having a second pipe first end;
- a coupling having a body, said body having a coupling first end and a coupling second end, a first inner tapered surface positioned adjacent said coupling first end and a second inner tapered surface positioned adjacent said coupling second end, a plurality of circumferential rings defined on said first inner tapered surface and said second inner tapered surface, said body having an outer surface and an inner surface, said inner surface defining a passageway, said inner surface including a lip positioned between said coupling first end and said coupling second end, said first pipe first end received by said coupling first end, said second pipe first end received by said coupling second end, said first pipe first end and said second pipe first end spaced on opposite sides of said lip;
- means for securing said first pipe to said coupling; and
- means for securing said second pipe to said coupling.
- 29.** A piping system comprising:
- a first pipe made of thermoplastic material having a first pipe first end;
- a second pipe made of thermoplastic material having a second pipe first end;
- a coupling having a body, said body having a coupling first end and a coupling second end, said coupling includes a first inner tapered surface positioned adjacent said coupling first end and a second inner tapered surface positioned adjacent said coupling second end, threads defined on said outer surface of said coupling adjacent said coupling first end and said coupling second end, axially extending ribs defined about said coupling outer surface and positioned between said threads positioned adjacent said coupling first end and said coupling second end, a plurality of circumferential rings defined on said first inner tapered surface and said second inner tapered surface, said body having an outer surface and an inner surface, said inner surface defining a passageway, said inner surface including a lip positioned between said coupling first end and said coupling second end, said first pipe first end received by said coupling first end, said second pipe first end received by said coupling second end, said first pipe first end and said second pipe first end spaced on opposite sides of said lip;
- means for securing said first pipe to said coupling; and
- means for securing said second pipe to said coupling.
- 30.** A piping system comprising:
- a first pipe made of thermoplastic material having a first pipe first end;
- a second pipe made of thermoplastic material having a second pipe first end;
- a nut;
- a coupling having a body, said body having a coupling first end and a coupling second end, pipe coupling threads defined on said outer surface of said coupling threadably engaged with said nut, a first tapered inner surface adjacent said coupling first end and a second inner tapered surface adjacent said coupling second end, a plurality of circumferential rings defined on said inner surface, said body having an outer surface and an inner surface, said inner surface defining a passageway,

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said inner surface including a lip positioned between said coupling first end and said coupling second end, said first pipe first end received by said coupling first end, said second pipe first end received by said coupling second end, said first pipe first end and said second pipe first end spaced on opposite sides of said lip;

means for securing said first pipe to said coupling; and means for securing said second pipe to said coupling, wherein said means for securing said first pipe to said coupling and said means for securing said second pipe to said coupling is through a fusion seal or a mechanical seal, said mechanical seal including a flexible body received between said pipe coupling and said first pipe, said mechanical seal body sealingly contacting said first tapered inner surface and circumferential ribs, and positioned between said first pipe and said pipe coupling, said flexible body held in place by said nut coating with said pipe coupling and an end of said flexible body.

31. A piping system as claimed in claim 30, wherein said nut includes inner threads that coact with said pipe coupling

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threads, said nut includes an annular lip that defines a passageway through which said first pipe passes, said annular lip contacts an end of said flexible body of said mechanical seal and holds said flexible body of said mechanical seal in place.

32. A piping system as claimed in claim 31, wherein said flexible body of said mechanical seal comprises a tapered portion adapted to coact with said first tapered inner surface of said pipe coupling.

33. A piping system as claimed in claim 32, wherein said flexible body of said mechanical seal includes an inner surface having a circumferential rings defined on an inner surface for coating with said first pipe.

34. A piping system as claimed in claim 32, further comprising a ring extending from an inner surface of said flexible body of said mechanical seal for coating with a recess defined on an outer surface of said pipe for aligning said mechanical seal, said first pipe and said pipe coupling.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,250,686 B1
DATED : June 26, 2001
INVENTOR(S) : Allen R. Becker et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 1,

Line 31, "togther" should read -- together --.

Column 2,

Line 24, "there through" should read -- therethrough --.

Line 36, after "each" insert -- of --.

Line 56, "a elevational" should read -- an elevational --.

Column 3,

Line 22, "thermoplastic 14" should read -- thermoplastic pipe 14 --.

Line 30, "pipe 14 first end" should read -- pipe first end --.

Column 5,

Line 20, after "is to" insert -- be --.

Column 10, claim 14,

Line 14, after "having" delete "a".

Line 36, after "defining a passageway," delete "said inner surface defining a passageway," (duplicate text)

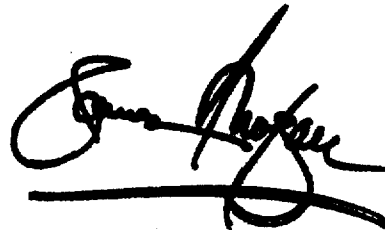
Column 14, claim 33,

Line 13, after "having" delete "a".

Signed and Sealed this

Fifteenth Day of January, 2002

Attest:



Attesting Officer

JAMES E. ROGAN
Director of the United States Patent and Trademark Office